



“Gheorghe Asachi” Technical University of Iasi, Romania



PREDICTING ACID ROCK DRAINAGE FROM A NICKEL MINE WASTE PILE AND METAL LEVELS IN SURROUNDING SOILS

Artwell Kanda^{1*}, George Nyamadzawo¹, Jephita Gotosa¹,
Nathan Nyamutora¹, Willis Gwenzi²

¹Department of Environmental Science, Bindura University of Science Education, P. Bag 1020 Bindura, Zimbabwe

²Department of Soil Science and Agricultural Engineering, University of Zimbabwe,
P.O. Box MP 167 Mt. Pleasant, Harare, Zimbabwe

Abstract

Acid-base accounting was applied to evaluate the acid generating potential of waste rock dumps of different ages at a nickel mine in Zimbabwe. Metal concentrations in soils surrounding the dumps were also assessed. The net neutralising potential (NNP) of waste rock samples was derived from the maximum potential acidity (MPA) and the neutralising potential (NP). MPA and NP were determined based on total sulphur and acid consumption respectively. Waste rock dumps (WRDs) had more ($p < 0.05$) sulphur (2.7-3.3%) than the control (0.8±0.03%). MPA values were 103.1±9.27, 103.1±6.33, 84.4±4.19 and 24.7±0.10 kgCaCO₃tonne⁻¹ for WRD-0 (fresh), WRD-8 (8years), WRD-16 (16years) and control waste rock samples respectively. NNP values for the WRDs (5.0-7.9 kgCaCO₃tonne⁻¹) were lower ($p < 0.05$) than those for the control (101.16±0.10 kgCaCO₃tonne⁻¹). Neutralising potential ratios (NPRs) were 1.1±0.10, 1.1±0.06, 1.1 ±0.03 and 5.1±0.01 for WRD-0, WRD-8, WRD-16 and control samples respectively. Mean metal concentrations in the surrounding soils were higher ($p < 0.05$) at all soil depths than the control. Concentrations were 195.1±4.60(Ni), 131.7±4.90(Cu), 60.0±1.77(Zn), 1220.5±9.44(Fe) and 7.0 ±0.210.14 mg/kg(Pb) in the 0-30 cm soil depth. Values generally decreased with soil depth, suggesting a surface source for the metals. The NNP and NPR criteria indicated uncertainty in ARD potential from the WRD samples. The study showed that ABA results were inconclusive but the technique remains important as an alternative for rapid preliminary tests. For inconclusive ABA results, a precautionary measure would be to consider the material as potentially acid generating. To prevent the acidic drainage, neutralization with alkaline material and use of engineered containment systems are advisable.

Keywords: acid-base accounting, acid rock drainage, environmental pollution, heavy metal, mine waste dump

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* Author to whom all correspondence should be addressed: e-mail: a_zkanda@yahoo.com; Phone: +263-271-7531; Fax: +263-271-7531